

WHAT IS CLAIMED IS:

5

1. A method for reducing an electromagnetic disturbance wave generated at an electronic apparatus, by covering the electronic apparatus with a housing which is formed by a material having a shield effect against an electromagnetic wave; comprising:

10 providing a space forming part for radiation of heat or wiring at the housing, so that a longitudinal direction of the space forming part is along a surface electric current distribution in a case where the space forming part is not provided at
15 the housing.

20

2. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the housing is formed by a material including a conductor or a semiconductor which has a volume resistivity of less than or equal to $10^4 \Omega \text{cm}$.

5

3. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the space forming part is formed so as to have a slit shape or a rectangular shape, and the space forming part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current of the housing.

20

4. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 3,

wherein the housing has a rectangular parallelepiped shape, and

25

the space forming part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

5

5. The method for reducing an
10 electromagnetic disturbance wave generated as claimed in claim 1,

wherein the space forming part is formed so as to have a slit shape or a rectangular shape, and

the space forming part in the longitudinal
15 direction is formed radially from a center part of a magnetic field situated at an inside part of the housing, calculated by a designated numerical formula.

20

6. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 1,

wherein a measurement of the housing is set so that a resonance frequency of an electromagnetic wave in the housing is generated only by a frequency higher than an upper limit frequency of an EMI
5 (ElectroMagnetic Interference) regulation.

10 7. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein a hole forming part other than the space forming part is provided, and

15 a size of the hole forming part is set so as to be less than or equal to one fourth, more preferably less than or equal to one tenth, of the length of an electromagnetic wave to be reduced.

20

8. The method for reducing an electromagnetic disturbance wave generated as claimed
25 in claim 1,

wherein the space forming part is provided at an upper or lower part, or the upper and lower parts of the housing.

5

9. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the housing has a connection part, and

the connection part in the longitudinal direction is provided so as to be along the longitudinal direction of the space forming part.

20 10. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the housing has a connection part, and

the longitudinal direction of the connection part is along a surface electric current distribution in a case where the connection part is not provided at the housing.

5

11. The method for reducing an
10 electromagnetic disturbance wave generated as claimed in claim 10,

wherein the connection part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric
15 current of the housing.

20 12. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 10,

wherein the housing has a rectangular parallelepiped shape, and

the connection part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

5

13. The method for reducing an
10 electromagnetic disturbance wave generated as claimed in claim 1,

wherein the housing has a connection part having a good electrical resistance and a connection part having a bad electrical resistance, and

15 the connection part having the bad electrical resistance in a longitudinal direction is along a surface electric current distribution in a case where the connection part having the bad electrical resistance is not provided at the housing.

20

14. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 13,

5 wherein the connection part having the bad
electrical resistance in a longitudinal direction is
formed radially from a gush part or a concentration
part of the surface electric current of the housing.

10

15. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 13,

15 wherein the housing has a rectangular
parallelepiped shape, and

the connection part having the bad
electrical resistance in the longitudinal direction
is formed radially from a gush part or a
20 concentration part of the surface electric current
calculated by a designated numerical formula.

25

16. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 1,

wherein the space forming part is arranged
5 in a direction in which a flow of a cooling medium
for elimination of heat or air change is not
disturbed.

10

17. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 1,

15 wherein a pipe for communicating between an
inside and an outside of the housing is provided at
the housing, and

a width of an opening part of the pipe is
set so as to be less than or equal to a half of a
20 wavelength of a frequency to be reduced.

18. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein a harness or an electrical wire or
5 cord for communicating information or electric power between the electric apparatus situated at the inside of the housing and an outside of the housing, is provided at the housing, so as to not disturb a surface electrical current distribution in a case
10 where the harness or the electrical wire or cord is not provided at the housing.

15

19. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein an electric optical conversion
20 element for converting an electric signal of the electric apparatus provided at an inside of the housing to an optical signal, an optical fiber for sending the optical signal converted by the electric optical conversion element from the space forming
25 part to an outside of the housing, and an optical

electric conversion element for converting the optical signal which is sent to the outside of the housing by the optical fiber to an electric signal, are provided,

5 so that the electric signal of the electric apparatus in the housing is converted to the optical signal by the electric optical conversion element, the converted optical signal is sent from the space forming part to the optical electrical conversion
10 element at the outside part of the housing and is converted to the electric signal, and

 therefore information is communicated between the electric apparatus situated at the inside of the housing and the outside of the housing.

15

20. The method for reducing an
20 electromagnetic disturbance wave generated as claimed in claim 1,

 wherein an electric infrared conversion element for converting an electric signal of the electric apparatus provided at an inside of the
25 housing to an infrared signal, and an infrared

electric conversion element for converting the infrared signal which is converted by the electric infrared conversion element to an electric signal, are provided,

5 so that the electric signal of the electric apparatus in the housing is converted to the infrared signal by the electric infrared conversion element, the converted infrared signal is sent from the space forming part to the outside part of the housing, and
10 the infrared signal sent to the outside part of the housing is converted to the electric signal by the infrared electric conversion element, and

 therefore information is communicated between the electric apparatus situated at the inside
15 of the housing and the outside of the housing.

20 21. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

 wherein a heat pipe for radiating heat generated at the electric apparatus provided at the
25 inside of the housing to an outside part of the

housing, is provided along a wall surface of the housing.

5

22. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

10 wherein the housing is formed by a metal material.

15

23. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

 wherein the housing has an internal surface
20 or external surface where a thin film formed by a conductor is applied.

25

24. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 23,

wherein the housing is formed by a material
5 having a volume resistivity of greater than or equal to $10^8 \Omega \text{cm}$, and

the housing has an internal surface or external surface where a thin film formed by a material having a volume resistivity of less than or
10 equal to $10^{-4} \Omega \text{cm}$ is applied.

15 25. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 24,

wherein the housing is formed by a plastic material, and

20 the housing has an internal surface or external surface where a metal thin film is applied.

26. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 23,

5 wherein a thickness of the thin film is
greater than a skin depth of a skin effect at a lower
limit frequency under an EMI (ElectroMagnetic
interference) regulation.

10

27. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 23,

15 wherein the thin film layer is glued to the
housing via an adhesion layer, and

a sticking part of the thin film, for gluing
the thin film layer, is provided in a direction along
a surface electric current distribution of the
20 housing in a case where the sticking part is not
provided.

25

28. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 27,

5 wherein the sticking part of the thin film
layer in the longitudinal direction is formed
radially from a gush part or a concentration part of
the surface electric current of the housing.

10

29. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 28,

15 wherein the housing has a rectangular
parallelepiped shape, and

the sticking part for the thin film layer in
the longitudinal direction is formed radially from a
gush part or a concentration part of the surface
20 electric current calculated by a designated numerical
formula.

25

30. The method for reducing an
electromagnetic disturbance wave generated as claimed
in claim 23,

5 wherein a metal pipe for communicating
between an inside and an outside of the housing is
provided at the housing so as to come in contact with
the thin film layer.

10

31. A housing structure for reducing an
electromagnetic disturbance wave generated at an
electronic apparatus, by covering the electronic
15 apparatus with a housing which is formed by a
material having a shield effect against an
electromagnetic wave; comprising:

a space forming part for radiation of heat
or wiring at the housing,

20 wherein a longitudinal direction of the
space forming part is along a surface electric
current distribution in a case where the space
forming part is not provided at the housing.

25

32. The housing structure as claimed in
claim 31,

wherein the housing is formed by a material
including a conductor or a semiconductor which has a
5 volume resistivity of less than or equal to $10^4 \Omega \text{cm}$.

10 33. The housing structure as claimed in
claim 31,

wherein the space forming part is formed so
as to have a slit shape or a rectangular shape, and
the space forming part in the longitudinal
15 direction is formed radially from a gush part or a
concentration part of the surface electric current of
the housing.

20

34. The housing structure as claimed in
claim 33,

wherein the housing has a rectangular
25 parallelepiped shape, and

the space forming part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

5

35. The housing structure as claimed in
10 claim 31,

wherein the space forming part is formed so as to have a slit shape or a rectangular shape, and

the space forming part in the longitudinal direction is formed radially from a center part of a
15 magnetic field situated at an inside part of the housing, calculated by a designated numerical formula.

20

36. The housing structure as claimed in
claim 31,

wherein a measurement of the housing is set so that a resonance frequency of an electromagnetic
25 wave in the housing is generated only by a frequency

higher than an upper limit frequency of an EMI
(ElectroMagnetic Interference) regulation.

5

37. The housing structure as claimed in
claim 31,

wherein a hole forming part other than the
10 space forming part is provided, and

a size of the hole forming part is set so as
to be less than or equal to one fourth, more
preferably less than or equal to one tenth, of the
wavelength of an electromagnetic wave to be reduced.

15

38. The housing structure as claimed in
20 claim 31,

wherein the space forming part is provided
at an upper or lower part, or the upper and lower
parts of the housing.

25

39. The housing structure as claimed in
claim 31,

wherein the housing has a connection part,
and

5 the connection part in the longitudinal
direction is provided so as to be along the
longitudinal direction of the space forming part.

10

40. The housing structure as claimed in
claim 31,

wherein the housing has a connection part,
15 and

the longitudinal direction of the connection
part is along a surface electric current distribution
in a case where the connection part is not provided
at the housing.

20

41. The housing structure as claimed in
25 claim 40,

wherein the connection part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current of the housing.

5

42. The housing structure as claimed in
10 claim 40,

wherein the housing has a rectangular parallelepiped shape, and

the connection part in the longitudinal direction is formed radially from a gush part or a
15 concentration part of the surface electric current calculated by a designated numerical formula.

20

43. The housing structure as claimed in claim 31,

wherein the housing has a connection part having a good electrical resistance and a connection
25 part having a bad electrical resistance, and

the connection part having the bad
electrical resistance in a longitudinal direction is
along a surface electric current distribution in a
case where the connection part having the bad
5 electrical resistance is not provided at the housing.

10 44. The housing structure as claimed in
claim 43,

wherein the connection part having the bad
electrical resistance in a longitudinal direction is
formed radially from a gush part or a concentration
15 part of the surface electric current of the housing.

20 45. The housing structure as claimed in
claim 43,

wherein the housing has a rectangular
parallelepiped shape, and

the connection part having the bad
25 electrical resistance in the longitudinal direction

is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

5

46. The housing structure as claimed in claim 31,

10 wherein the space forming part is arranged in a direction in which a flow of a cooling medium for elimination of heat or air change is not disturbed.

15

47. The housing structure as claimed in claim 31,

20 wherein a pipe for communicating between an inside and an outside of the housing is provided at the housing, and

 a width of an opening part of the pipe is set so as to be less than or equal to a half of a
25 wavelength of a frequency to be reduced.

48. The housing structure as claimed in
claim 31,

wherein a harness or an electrical wire or
cord for communicating information or electric power
5 between the electric apparatus situated at the inside
of the housing and an outside of the housing, is
provided at the housing, so as to not disturb a
surface electrical current distribution in a case
where the harness or the electrical wire or cord is
10 not provided at the housing.

15 49. The housing structure as claimed in
claim 31,

wherein an electric optical conversion
element for converting an electric signal of the
electric apparatus provided at an inside of the
20 housing to an optical signal, an optical fiber for
sending the optical signal converted by the electric
optical conversion element from the space forming
part to an outside of the housing, and an optical
electric conversion element for converting the
25 optical signal which is sent to the outside of the

housing by the optical fiber to an electric signal,
are provided,

so that the electric signal of the electric
apparatus in the housing is converted to the optical
5 signal by the electric optical conversion element,
the converted optical signal is sent from the space
forming part to the optical electrical conversion
element at the outside part of the housing and is
converted to the electric signal, and

10 therefore information is communicated
between the electric apparatus situated at the inside
of the housing and the outside of the housing.

15

50. The housing structure as claimed in
claim 31,

wherein an electric infrared conversion
20 element for converting an electric signal of the
electric apparatus provided at an inside of the
housing to an infrared signal, and an infrared
electric conversion element for converting the
infrared signal which is converted by the electric

infrared conversion element to an electric signal,
are provided,

so that the electric signal of the electric
apparatus in the housing is converted to the infrared
5 signal by the electric infrared conversion element,
the converted infrared signal is sent from the space
forming part to the outside part of the housing, and
the infrared signal sent to the outside part of the
housing is converted to the electric signal by the
10 infrared electric conversion element, and

therefore information is communicated
between the electric apparatus situated at the inside
of the housing and the outside of the housing.

15

51. The housing structure as claimed in
claim 31,

20 wherein a heat pipe for radiating a heat
generated at the electric apparatus provided at the
inside of the housing to an outside part of the
housing, is provided along a wall surface of the
housing.

25

52. The housing structure as claimed in
claim 31,

wherein the housing is formed by a metal
material.

5

53. The housing structure as claimed in
10 claim 31,

wherein the housing has an internal surface
or external surface where a thin film formed by a
conductor is applied.

54. The housing structure as claimed in
15 claim 53,

wherein the housing is formed by a material
having a volume resistivity of greater than or equal
to $10^8 \Omega \text{cm}$, and

the housing has an internal surface or
20 external surface where a thin film formed by a
material having a volume resistivity of less than or
equal to $10^{-4} \Omega \text{cm}$ is applied.

25

55. The housing structure as claimed in
claim 54,

wherein the housing is formed by a plastic
material, and

5 the housing has an internal surface or
external surface where a metal thin film is applied.

10

56. The housing structure as claimed in
claim 53,

wherein a thickness of the thin film is
greater than a skin depth of a skin effect at a lower
15 limit frequency under an EMI (ElectroMagnetic
Interference) regulation.

20

57. The housing structure as claimed in
claim 53,

wherein the thin film layer is glued to the
housing via an adhesion layer, and

a sticking part of the thin film, for gluing the thin film layer, is provided in a direction along a surface electric current distribution of the housing in a case where the sticking part is not
5 provided.

10 58. The housing structure as claimed in claim 57,

wherein the sticking part of the thin film layer in the longitudinal direction is formed radially from a gush part or a concentration part of
15 the surface electric current of the housing.

20 59. The housing structure as claimed in claim 58,

wherein the housing has a rectangular parallelepiped shape, and

the sticking part for the thin film layer in
25 the longitudinal direction is formed radially from a

gush part or a concentration part of the surface
electric current calculated by a designated numerical
formula.

5

60. The housing structure as claimed in
claim 53,

10 wherein a metal pipe for communicating
between an inside and an outside of the housing is
provided at the housing so as to come in contact with
the thin film layer.

15

20

25